The present application is directed to, inter alia, a method of manufacturing a nitrogen-based semiconductor layer grown on a hetero-substrate, comprising the steps of:

forming, on a surface of the nitrogen-based semiconductor layer, a protection layer composed of at least one material selected from a group consisting of Au, Pt, Ti-Au, Pd-Au, Ni-Au, Ti-Pt-Au, AuZn, and AuGe, so that the protection layer covers at least the surface of the nitrogen-based semiconductor layer; and

etching out the hetero-substrate by the use of an etchant for the hetero-substrate to leave the nitrogen-based semi-conductor layer. This is the subject matter of Claim 15, the main independent claim presently being prosecuted and examined.

Kawai does not teach, disclose or suggest the present invention. More specifically, Kawai discloses the process of making a FET by growing GaN semiconductor layers on the surface of a sapphire substrate wherein the bottom surface of the sapphire substrate is processed by lapping using an abrasive liquid containing a diamond granular abrasive material and reducing the thickness of the sapphire substrate to 100 μm or less. Thereafter, the bottom surface of the sapphire substrate is processed by etching using an etchant of phosphoric acid or phosphoric acid/sulfuric acid mixed liquid to remove a strained layer by lapping. Then, after making a via hole by etching the bottom surface of the sapphire substrate, the GaN semiconductor layer at the bottom of the via hole is removed by RIE to expose an Au an electrically connected to the source of the GaN FET. Thereafter, a thick Au film electrically connected to the Au pad is made through via hole.

Kawai does not teach, disclose or suggest the use of a protection layer comprised of a material selected from group consisting of Au, Pt, Ti-Au, Pd-Au, Ni-Au, Ti-Pt-Au, AuZn, and AuGe. A review of Kawai clearly reveals that there is no mention therein of any material consisting of any of the aforementioned groups - - let alone a protection

layer on the surface of a nitrogen-based semiconductor layer consisting of any of the aforementioned groups. Furthermore, it does not teach, disclose or suggest that the protection layer composed of at least one of the aforementioned materials covers at least the surface of the nitrogen-based semiconductor, as claimed.

The Office Action refers to Figure 12 and column 12, line 45-67 and column 13 to column 14 of Kawai and alleges that Kawai teaches forming an InGaN layer forming metal layer "60" as a protection layer. Applicants disagree that Kawai teaches or discloses a protection layer therein.

Attention is directed to Figures 7-11 of Kawai and the text accompanying same. As described therein, the GaN semiconductor layer 22 is grown on a surface of a sapphire substrate 21 and is partially covered with a Au pad 24 and thereafter covered with an inter-layer insulating film 25. The Au pad 24 and the inter-layer insulating film 25 are finally left on the GaN semiconductor layer 22 together with the sapphire substrate 21, as shown in Figure 11.

From this fact, it is readily understood that Kawai never teaches etching both a downward side and an upward side of the GaN semiconductor layer 22 to leave the GaN semiconductor layer 22 alone. In other words, Kawai never teaches leaving the nitrogen-based semi-conductor layer alone, as required in the present invention. Therefore, the Au pad 24 partially covers the GaN semiconductor layer and never covers the entire surface of the GaN semiconductor layer 22. This shows that the Au pad 24 never serves as a protection layer, because the GaN semiconductor layer is partially etched by an etchant through a portion uncovered with the Au pad 24. Thus, unlike the present invention, Kawai never teaches or suggests forming a protecting layer composed of at least one material selected from a group consisting of Au, Pt, Ti-Au, Pd-Au, Ni-Au, Ti-Pt-Ar, AuZn and

AuGe. Moreover, it does teach or suggest that the protection layer covers at least the surface of the nitrogen based semi-conductor layer.

Moreover, unlike the present invention, Kawai does not teach, disclose or suggest leaving the nitrogen-based semi-conductor layer alone. Even the Office Action agrees, as the Office Action admits that Kawai does not teach removing the entire substrate.

The secondary reference, Motoki, et al., does not overcome the inadequacies of the primary reference.

Motoki, et al. are directed to a light emitting device obtained by forming a gallium nitride compound layer on a GaAs substrate and thereafter at least partially removing the GaAs substrate. In Motoki, et al., a gallium nitride compound layer is formed on a GaAs substrate, and thereafter the GaAs substrate is at least partially removed for forming the light emitting device. Due to the removal of the GaAs substrate, the quantity of light absorption is reduced, relative to the device in which the GaAs is maintained.

In Motoki, et al., a GaAs substrate 8 is partially removed to expose a surface of a GaN buffer layer 1 on the removed portion. In addition, the GaAs substrate 8 may be entirely removed by etching, thereby forming an epitaxial wafer consisting of only a nitride mixed crystal layer 9 (column 7, lines 31 to 33). This nitride mixed crystal layer 9 is composed of a plurality of GaN epitaxial layers 2 to 6 and is not covered with any protection film at all.

Thus, Motoki, et al. never teach etching from both downward and upward sides of the GaAs substrate 8.

In addition, Motoki, et al. do not teach, disclose or suggest forming on the surface of a nitrogen based semiconductor layer a protection layer comprised of any of the aforementioned materials. More specifically, a review of Motoki, et al. clearly reveals that

it does not even mention a material used in the process thereof comprised of Au, Pt, Ti-Au, Pd-Au, Ni-Au, Ti-Pt-Au, AuZn, or AuGe - - let alone a protection layer comprised of such material. Moreover, it does not teach, disclose or suggest that the protection layer covers at least the surface of the nitrogen based semiconductor layer. Further, it does not teach or suggest leaving the nitrogen-based semiconductor alone, as required by the present invention.

Thus, since neither reference teaches or discloses forming a protection layer composed of material selected from a group consisting of Au, Pt, Ti-Au, Pd-Au, Ni-Au, Ti-Pt-Au, AuZn, and AuGe, the combination of Kawai and Motoki, et al. do not teach, disclose or suggest the step for forming, on a surface of the nitrogen based semiconductor layer, a protection layer composed of any of the aforementioned material, which is one of the steps of the present invention. Moreover, the prior art reference in combination does not suggest a protection layer composed of the aforementioned material covering at least the surface of the nitrogen-based semiconductor layer. Thus, the prior art reference does not teach, disclose or suggest the present invention. Nor does the combination teach or suggest leaving the nitrogen-based semiconductor layer alone.

In contrast, in the present invention, there is a step of forming on the surface of the nitrogen-based semiconductor layer a protection film as illustrated in Figures 2A and 5A. Under the circumstances, etching is executed from both downward and upward sides to leave the nitrogen based semi-conductor layer (15, 35) alone. Thus, the prior art reference does not teach, disclose or suggest the present method as claimed.

It appears that the Office Action is focusing on Claim 10 for its rejection of the claims. Claim 10 recites that the nitrogen based semiconductor layer is $In_xGa_{1-x}N$ or $Al_xGa_{1-x}N$. However, Claim 10 is not an independent claim but is dependent on Claim 15.

Inasmuch as Claim 10 and the other claims in the application are dependent on Claim 15, it incorporates the subject matter therein. Since the subject matter of Claim 15 is not rendered obvious by the prior art, the claims dependent thereon including Claim 10 is not rendered obvious by the prior art.

Therefore, for the reasons presented, the rejection of Claims 10-20 under 35 U.S.C. §103 is overcome; withdrawal thereof is respectfully requested.

Thus, in view of the Remarks hereinabove, it is respectfully submitted that the present case is in condition for allowance, which action is earnestly solicited.

Respectfully submitted,

Mark J. Cohen
Registration No. 32, 211

Scully, Scott, Murphy & Presser
400 Garden City Plaza
Garden City, NY 11530
(516) 742-4343
MJC:lf